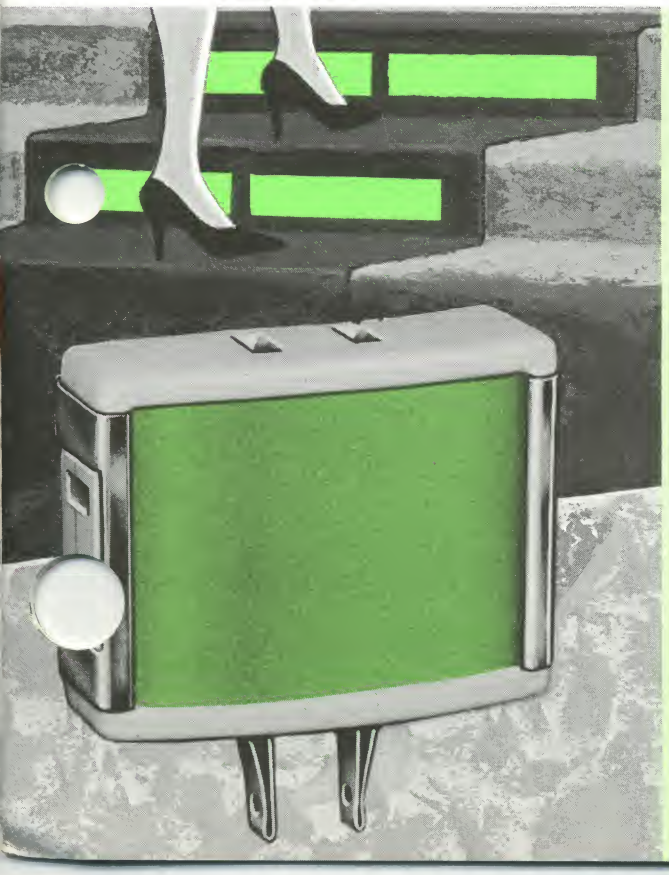
electroluminescent LAMPS



MINIATURE LAMP DEPARTMENT

GENERAL ELECTRIC

Electroluminescent Lamps

. . . wafer-thin lights by the square inch

. . . uniform brightness over entire surface

. . . can be mounted on flat or curved surfaces

. . . available in white, yellow, green or blue colors

. . . long dependable life

. . . customer-specified shapes and designs in production-line quantities

**Drawing by Preston Blair from "Animation" Published by Walter T. Foster*

THINNER THAN A DIME . . . FLEXIBLE AS A PLAYING CARD . . .

General Electric Electroluminescent Lamps are designed and fabricated into any customer-specified shape for an unlimited variety of low-brightness lighting and luminous product applications. Lightweight, ruggedly constructed, these "two-dimensional" surface light sources can be made as small as a shirt button or as large as a sheet of music. They can be mounted on flat or curved products. The lamps produce cool, softly glowing light and can be operated continuously or automatically cycled for signaling, data indication, advertising displays and scores of other animated lighting effects. Additional advantages of the unique lamps are long operating life plus economies in power consumption and maintenance.

Operation of electroluminescent lamps is simple. Light emanates from crystalline powders, or phosphors, sandwiched between the lamp's two electrically conducting surfaces, one of which is translucent. When the lamp is connected to line voltage the powders absorb the electrical energy and convert it instantaneously into light with minimal heat. This simplified electrical construction permits the lamps to be connected directly to line current without the need for ballasts, starters or any other auxiliary electrical equipment.

While flexibility and thinness of construction are major advantages of General Electric Electroluminescent Lamps, they also can be furnished with stiff backings for uses requiring rigidity. All lamps are supplied with a durable plastic covering to assure protection from the effects of moisture and any weather conditions. Under normal use, the lamps will not chip, crack or break from impact or mechanical vibration.

General Electric Electroluminescent Lamps come in white plus three basic colors — green, yellow, and blue — which are ideally suited for a wide range of commercial and domestic applications. In addition, a great variety of other colors can be produced by using fluorescent materials in conjunction with EL lamps.

This publication shows many practical applications where design requirements call for extremely thin, uniformly lighted surfaces. Also included is technical design information which should be of value to architects, product designers, and engineers in incorporating the many benefits of electroluminescent lamps into a host of manufactured products and architectural or interior design uses. In doing so, the functional uses and salability of the products can be greatly enhanced.

A NEW WAY TO PRODUCE LIGHT IN MOTION — This action sequence of an attention-getting, animated display shows it's now possible to create separately controlled lighted areas in different shapes in a single electroluminescent lamp. Other similar uses include advertising signs . . . signaling and indicating lights for instrument panels, computers, and electronic equipment . . . pulsating lights for attraction and warning . . . readout lamps.

PRODUCT APPLICATIONS FOR ELECTRO-LUMINESCENT LAMPS

Animated advertising displays . . . flashing or continuously lighted commercial signs

Plug-in sales presentation kits

Animated or decorative lighting for back bar panels . . . accent lighting in atmosphere areas of cocktail lounges and restaurants

Lighted railings for stairways . . . built-in or attached step lighting

Luminescent appointments for commercial aircraft . . . pleasure boats . . . commercial ocean liners

Home appliance control panels . . . elevator control panels

Control panels for aircraft and space vehicle applications . . . submarine and radar control centers

Photographic laboratory applications . . . copiers . . . light tables . . . color analyzers

Readout lamps for electronic computers and stock listing boards

Warning lights in darkened areas . . . flashing or pulsing

Clock faces . . . television and radio control panels . . . electronic instrument dials

Residential address numbers . . . home light switch and outlet plates . . . decorative and safety night lighting in the home

Lighted storybook characters for children's rooms or nurseries

Decorative border lighting for paintings and other art objects . . . backlighting of transparencies

Backlighting for home aquariums . . . home patio decorations

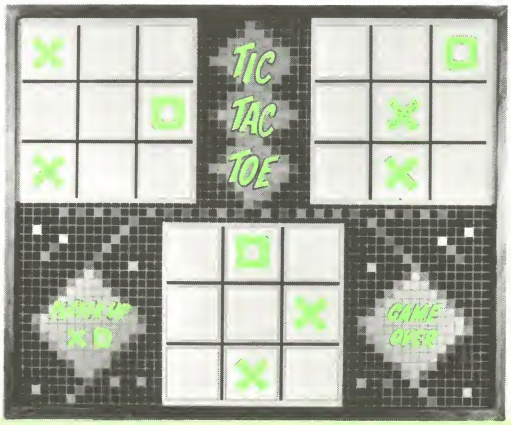
Courtesy lights in theaters and concert halls . . . lighted numbers on seat arms

Accent or decorative lighting

1

2

3



5

6

7

(1) Precision darkroom instrument for simple dialing of brightness for controlling contrast of photographic paper or film. An electroluminescent lamp for light exposure surface offers the design advantages of extreme thinness, uniform adjustable brightness, and a large, easily replaced flat surface. **(2)** Electroluminescent lamps serve as stimulating design elements in advertising display units. The softly glowing area light sources can be supplied in a variety of shapes, sizes and colors and automatically cycled to create attention-getting, animated messages in light. **(3)** Eye-catching, flashing price marker brings feature items to the attention of shoppers. Rugged, long life EL lamps when bent slightly, slide easily into a simple slotted price-card holder. **(4)** Electroluminescent lamp is used as combination safety light and colorful decorative accent beneath step. Lamp's soft glow prevents accidents and serves as attractive interior design element. **(5)** This Tic-Tac-Toe game is one of a series of coin-operated games utilizing electroluminescent lighting. Games take minimum space because of El's thin, flexible size. Fast-action animation provides many hours of enjoyment. **(6)** Qualification test panel using an electroluminescent lamp as a light source. This is a type of plastic panel used in aircraft for the mounting of switches, rheostats, indicators, instruments, etc. **(7)** Meter face of photographic color analyzer consists of electroluminescent lamp with scale information on glowing surface for optimum readability. Any desired uniform dial brightness is easily set by operator.

OPERATING CHARACTERISTICS
of electroluminescent lamps

Brightness of electroluminescent lamps can be varied to suit design needs by changing applied line voltage or frequency. Some lamp phosphors used in electroluminescent lamps are more efficient than others, green being the best. Fig. 1 shows the spectral response curves for yellow, blue, and green colors of lamps operating on 60 and 400 cps frequencies.

In Fig. 2, the relationship of initial brightness versus lamp voltage at 400 cycles for the four phosphor colors are plotted. Note that the green lamp is about 100% higher in brightness than yellow or white lamps and three times as bright as the blue lamp over the range of applied voltage.

Higher frequencies increase the brightness of electroluminescent lamps for any applied voltage, Fig. 3. However, the effective life of lamps operated on 60-cycle power are 3 to 4 times as long as 400-cycle operation. An increase in applied voltage after several thousand hours of burning will increase the brightness and extend the burning hours of electroluminescent lamps.

Useful brightnesses can be expected for thousands of operating hours for many design applications with General Electric electroluminescent lamps. Brightnesses for the four EL lamp colors versus hours of operation are shown graphically in Fig. 4 for 120-volt, 60-cycle power. Fig. 5 shows brightness versus hours of operation for 400-cycle operation on 120 volts.

The usable life of the General Electric electroluminescent lamp is dependent on the ambient light at the location where the lamp is used. Thus, in areas of low ambient light, the lamp may have satisfactory brightness for thousands of hours while in more brightly lighted places it may not have enough brightness initially to be used.

It is anticipated that these lamps will be usable for about three years, whether or not they have been lighted. At the end of this period the brightness depreciation rate will begin to increase because of moisture absorption by the lamp.

The approximate initial current and wattage values per square foot of lamp are shown below. After 1000 hours of burning these values will drop to about 50%, depending on the color and actual operating conditions.

120 Volts	120 Volts
60 Cycles	400 Cycles
60 milliamperes	300 milliamperes
3.5 watts	16 watts

The power factor for electroluminescent lamps is leading, and initially is about 0.4. After 1000 hours of burning it is about 0.35 and after 5000 hours it is about 0.2. The initial capacitance per square inch is approximately 0.007 microfarads at 60 cycles, 120 volts and 0.005 microfarads at 400 cycles, 120 volts.

General Electric electroluminescent lamps are accepted under the Component Program of Underwriters' Laboratories, Inc.

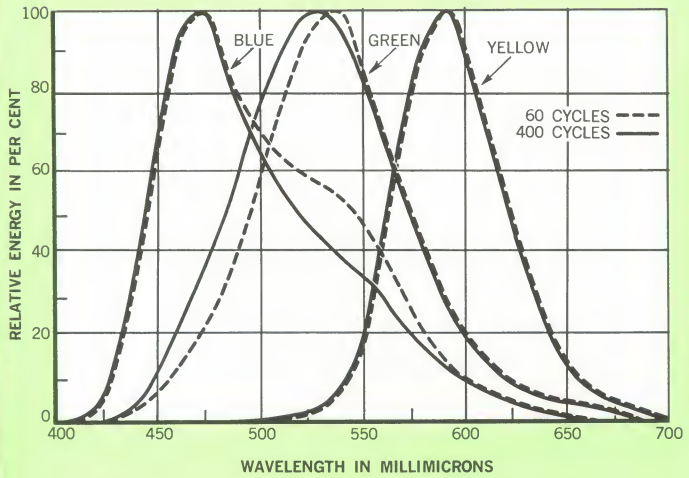


Figure 1

Figure 1
Spectral distribution curves for various colors of General Electric electroluminescent lamps when operated on 60- and 400-cycle power.

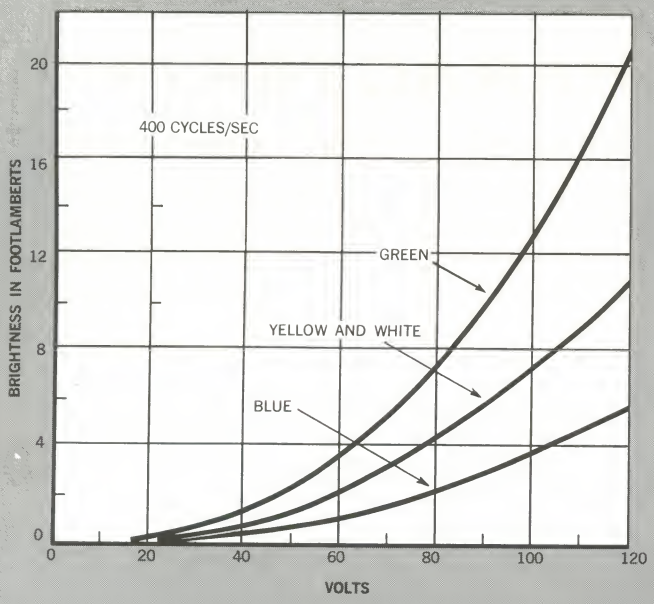


Figure 2

Figure 2
Initial brightness of EL lamp colors versus applied lamp voltage when operated on 400-cycle power.

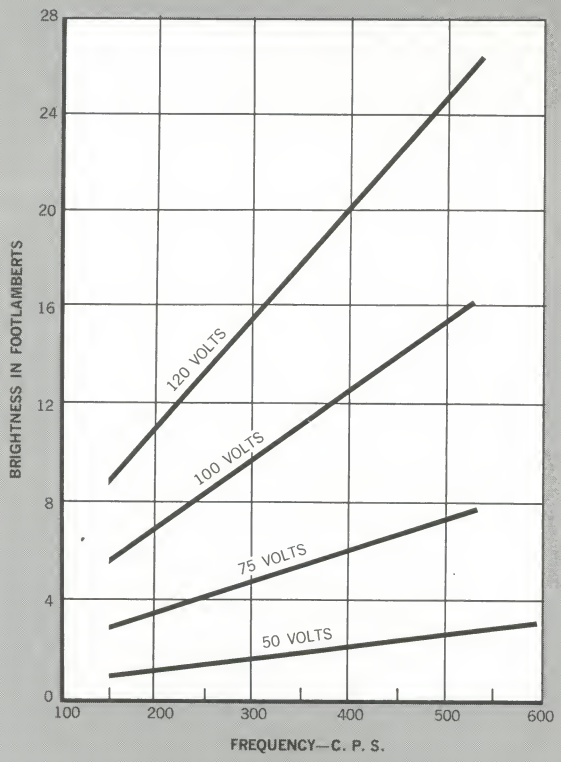


Figure 3

Figure 3
Initial brightness of green EL lamps versus line frequency for four constant-voltage conditions.

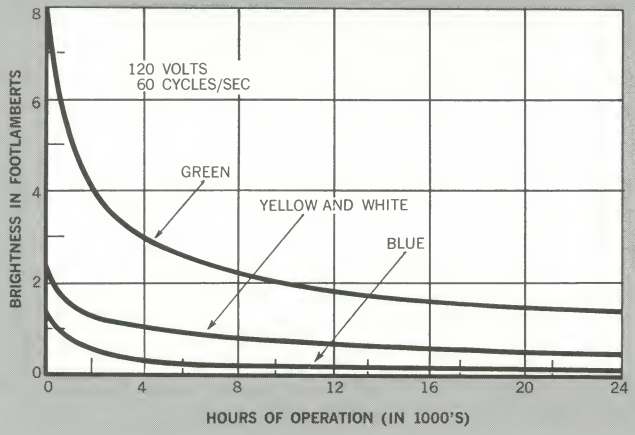


Figure 4

Figure 4
Brightness of four colors of 60-cycle lamps versus hours of operation on 120-volt, 60-cycle power. Relative humidity was 40% and ambient temperature was 76 F.

Figure 5
Brightness of four colors of 400-cycle lamps versus hours of operotion on 120-volt, 400-cycle power. Relative humidity was 40% and ambient temperature was 76 F.

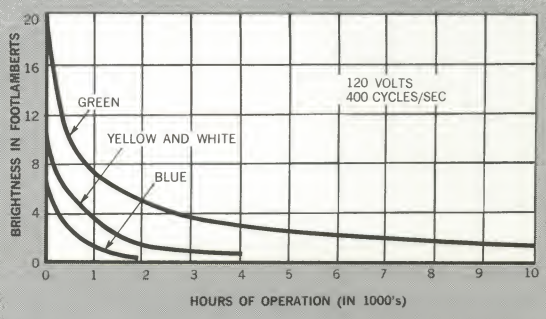


Figure 5

SELECTION DATA

LAMP SIZES AND SHAPES

Almost any two-dimensional shape of electroluminescent lamp can be specified from the size of a collar button to a rectangle measuring 12 x 14 inches. A 1/8 to 1/4 inch unlighted border depending on overall dimensions, is present on each lamp to insure proper edge sealing of the plastic.

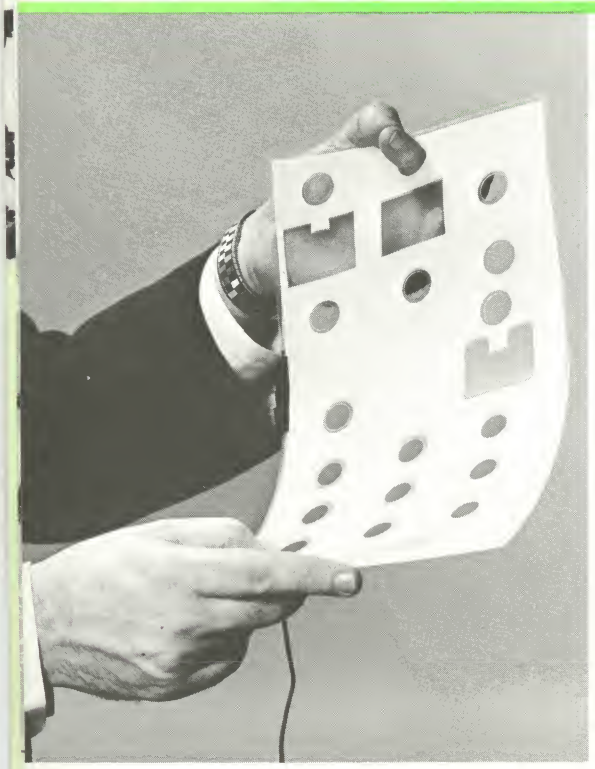
FLEXIBLE AND STIFF-BACKED LAMPS

Flexibility is an important design advantage of General Electric electroluminescent lamps. They can be mounted on or attached to flat objects or to curved surfaces of three-dimensional objects. For applications requiring rigidity, lamps are available with stiff backings. Flexible lamps are less than 1/32-inch thick and rigid lamps are about 1/16 inch thick.

Unlighted borders on stiff-backed electroluminescent lamps are slightly wider than on the flexible types. To the "Normal Unlighted Border Dimension" for flexible lamps, add 1/4 inch to the side where the connection eyelets are located and 1/16 inch to the other sides.

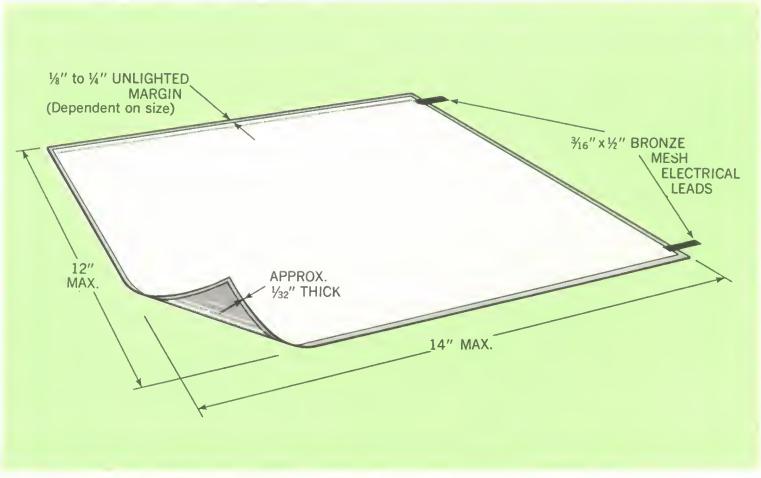
AVAILABILITY OF LAMP SAMPLES

Samples of electroluminescent lamps can be supplied in rectangular shapes up to 12 x 14 inches. Other shapes can be made, too, as long as they can be fitted into a 12 x 14 inch rectangle or smaller.

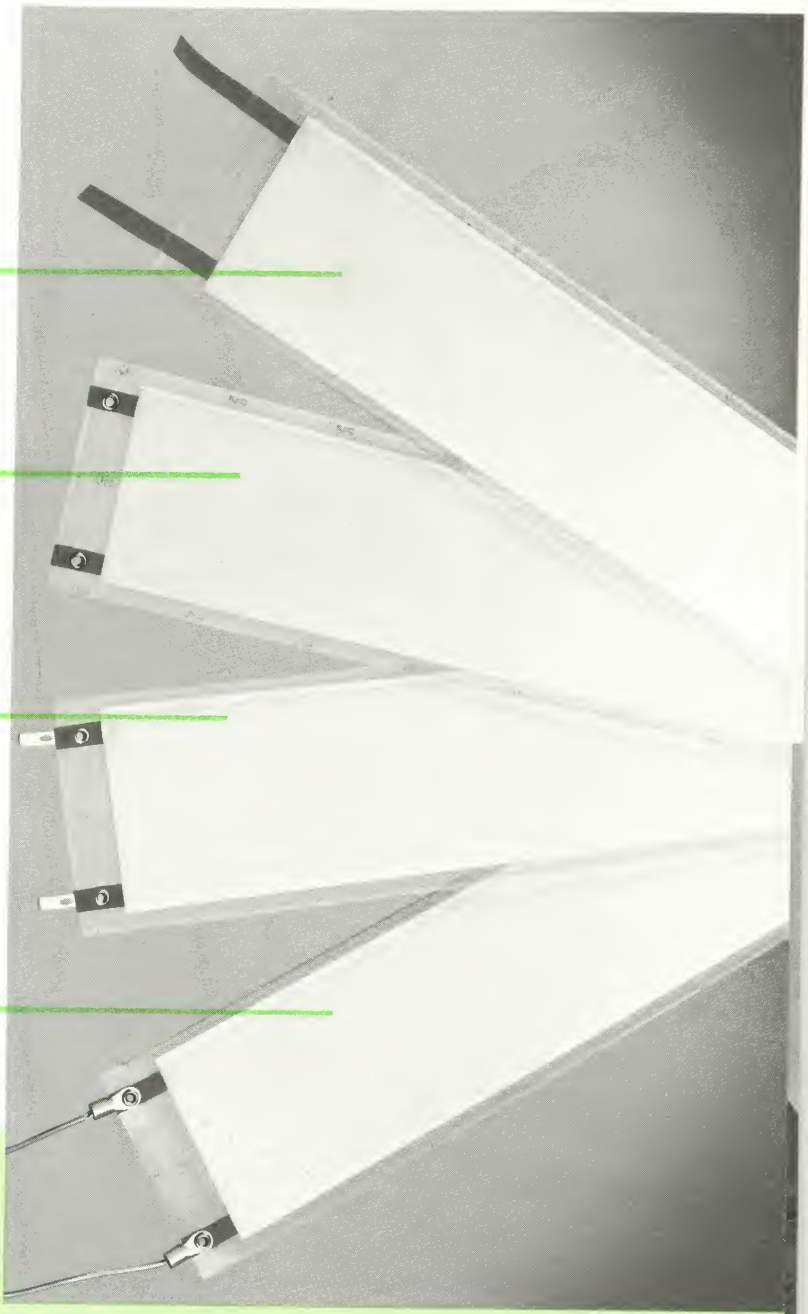


TOLERANCES ON DIMENSIONS FOR FLEXIBLE ELECTROLUMINESCENT LAMPS

Lamp Length (Inches)	Normal Unlighted Border Dimensions (Inches)	Tolerances on Length and Width (Inches)
Up to 6	1/8 ± 1/32	± 1/32
6+ to 12	3/16 ± 1/16	± 1/16
12+ to 14	1/4 ± 3/32	± 3/32



ELECTRICAL CONNECTIONS can be made to G-E electroluminescent lamps through a number of different ways and at practically any point around the edge of the lamp. Four of the most common include:



Type A
Bronze wire mesh leads for pressure or solder contacts and the thinnest possible connection.

Type B
Metal eyelets through bronze wire mesh for pressure contacts or other connectors.

Type C
Male connectors to which mating connectors can be attached.

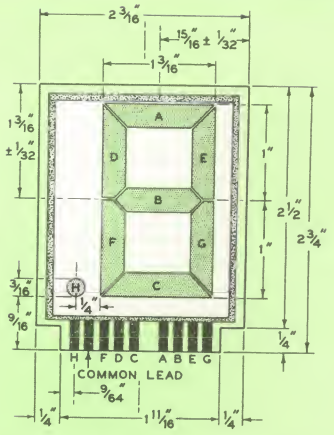
Type D
Terminal connections with insulated wire leads.

ELECTROLUMINESCENT READOUT LAMPS

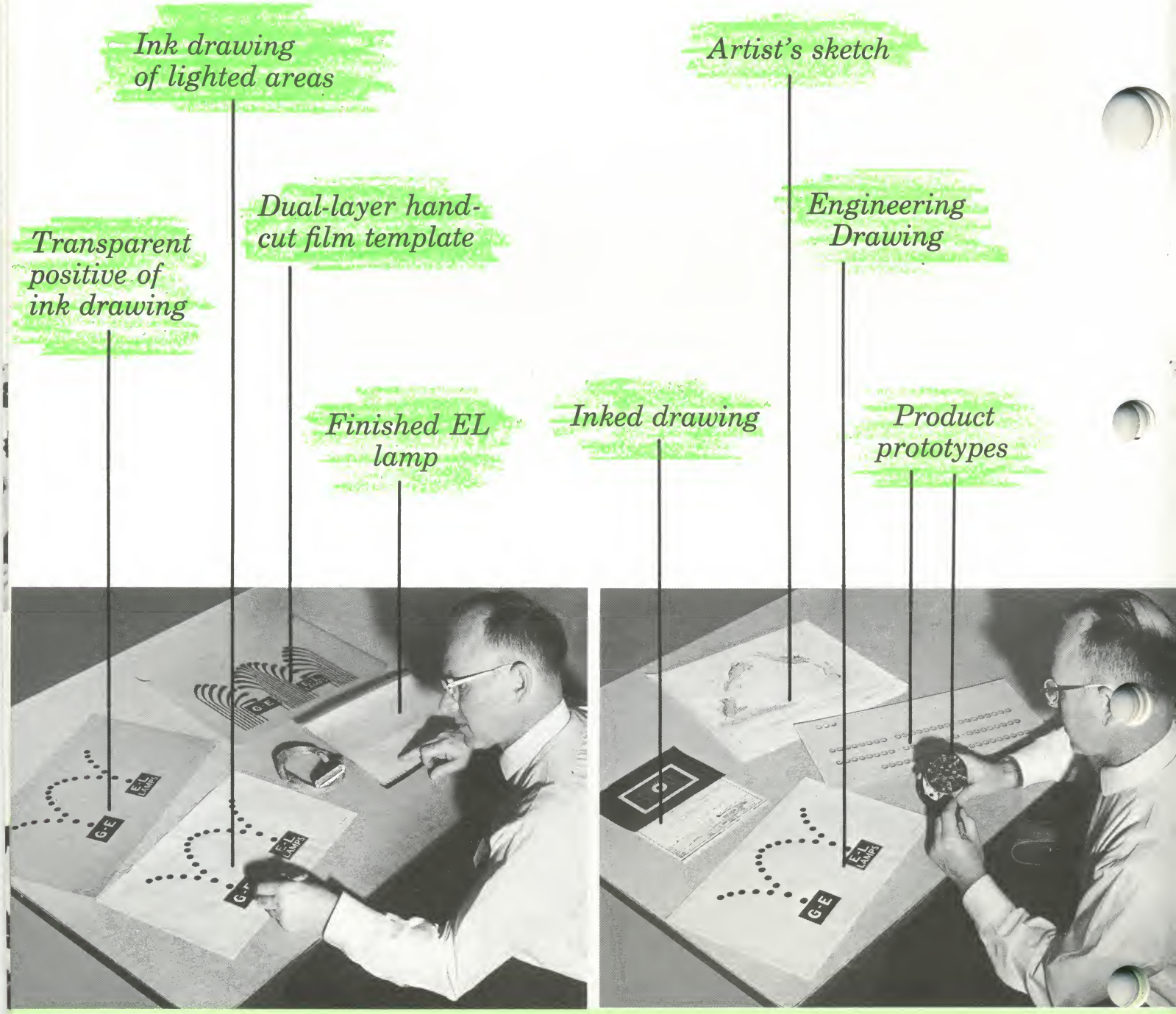
Readout lamps using electroluminescent lamps are now available from General Electric. These lamps may be ordered in three sizes (½", 1", and 2") and eight combinations of digits.

G-E Readout lamps are light-weight, rugged, thin, completely solid state, compact, and designed for wide angle viewing. They are available in 120V, 240V-60C or 120V-400C versions.

For complete mechanical and electrical specifications, ask your G-E representative for Bulletin #3-653.



TYPICAL EL READOUT
(2" Numeral)
ER81
(Shown Half Size)



HOW TO ORDER EL LAMPS

To order an electroluminescent lamp for a given product application, usually it is only necessary to supply your nearest G-E Miniature Lamp Department Sales Office with lamp dimensions, color, voltage, frequency and type of electrical connection. This procedure applies to circles, squares, rectangles, and other shapes where the full area is lighted.

More detailed drawings are necessary for more complex lamp shapes or lamps which will have discrete areas separately lighted. In these cases, full-size artwork should be supplied with lighted and unlighted portions clearly indicated. Again colors of each lighted area, voltage, frequency, and electrical connection information must be provided.

The illustration (above left) shows some of the steps from artwork to creating a finished animated EL display lamp.

Artwork, other design information, sketches, and the product are all usually needed in designing, engineering, and manufacturing more complex EL lamp shapes (above).

GENERAL ELECTRIC APPLICATION ENGINEERING SERVICE

The Miniature Lamp Department of General Electric offers complete application engineering assistance to all customers in applying electroluminescent lamps in product design. Each application of General Electric electroluminescent lamps is carefully studied for design and manufacturing feasibility to assure full customer satisfaction.

A well-staffed engineering department with extensive research and design facilities is available to help you. Contact your local G-E district office which is listed on the following page for more complete information.

GENERAL ELECTRIC MINIATURE LAMP SALES AND ORDER SERVICE OFFICES

	SALES OFFICES (To Obtain Sales and Technical Information) (Address)	(Zip)	(Telephone)	ORDER SERVICE OFFICES (To Order Lamps and to Obtain Shipping Information. Local Warehouse Stocks maintained at these Points) (Address)	(Zip)	(Telephone)
ATLANTA, GA.	Suite 2B, 359 E. Paces Ferry Road, N.E.	30305	237-0795	120 Ottley Dr., N.E., P. O. Box 13917	30424	875-0921
BALTIMORE, MD.	1401 Parker Rd. Mail: P.O. Box 7427 Arbutus, Md.	21227	242-5700	1401 Parker Road, Arbutus, Md. Mail: P.O. Box 7427, Baltimore, Md.	21227	242-5700
BOSTON, MASS.	50 Industrial Pl., Newton Upper Falls, Mass.	02164	332-6200	50 Industrial Place, Newton Upper Falls, Mass.	02164	332-6200
BUFFALO, N. Y.				98 Hydraulic St.	14210	856-0800
CAPE ELIZABETH, MAINE	29 Ocean View Road	04107	799-0221	Boston Service Dist., 50 Industrial Place, Newton Upper Falls, Mass.	02164	332-6200
CHARLOTTE, N. C.	1001 Tuckaseegee Rd., Mail: P.O. Box 17362	28211	376-6585	1001 Tuckaseegee Rd. Mail: P.O. Box 2144, Charlotte, N. C.	28201	376-6585
CHICAGO, ILL.	550 West Jackson Blvd.	60606	332-4712	4201 So. Pulaski Rd.	60632	254-6161
CINCINNATI, OHIO	49 Central Ave.	45202	421-6810	49 Central Ave.	45202	421-6810
CLEVELAND, OHIO	12910 Taft Ave. Mail: P.O. Box 2514	44108	266-4337	12910 Taft Ave. Mail: P.O. Box 2422	44112	266-4404
COLUMBUS, OHIO	766 Northwest Blvd.	43212	294-4115	Cleveland Serv. Dist., 12910 Taft Ave. Mail: P.O. Box 2422, Cleveland, Ohio	44112	266-4404
DALLAS, TEXAS	6500 Cedar Springs Rd., Mail: P.O. Box 35425	75235	351-3725	6500 Cedar Springs Rd. Mail: P.O. Box 35425	75235	351-3725
DAYTON, OHIO	225 N. Wilkinson St.	45402	223-7151	Cincinnati Serv. District, 49 Central Ave., Cincinnati, Ohio	45202	421-6810
DENVER, COLO.	6501 E. 44th Ave.	80216	388-4611	6501 E. 44th Ave.	80216	388-4611
DETROIT, MICH.	15135 Hamilton Ave.	48203	883-0200	15135 Hamilton Ave.	48203	883-0200
DULUTH, MINN.	126 North 7th Ave. East	55805	722-5549	Minneapolis Serv. Dist., Northwestern Terminal Bldg., 500 Stinson Blvd., Minneapolis, Minn.	55413	331-4050
EL PASO, TEXAS	2800 N. Stanton, Rm. 210	79902	533-1961	Dallas Service Dist., 6500 Cedar Springs Rd. Mail: P.O. Box 35425, Dallas, Texas	75235	351-3725
EXETER, N. H.				Boston Service Dist., 50 Industrial Place, Newton Upper Falls, Mass.	02164	332-6200
HOUSTON, TEXAS	5615 Lymbar Drive	77035	533-1961	P.O. Box 18265	77023	923-2549
				5534 Armour Drive	77020	
INDIANAPOLIS, IND.	2511-F-1 East 46 St.	46205	547-5511	Cincinnati Service Dist., 49 Central Ave., Cincinnati, Ohio	45202	421-6810
N. KANSAS CITY, MO.	200 East 16th Ave.	64116	471-3568	200 East 16th Ave.	64116	471-3568
LOS ANGELES, CALIF.	2747 S. Malt Ave.	90022	723-2541	2747 S. Malt Ave.	90022	723-2541
MEMPHIS, TENN.	2021 S. Latham St.	38109	948-2642	2021 S. Latham St.	38109	948-2642
MIAMI, FLA.	1310 N. W. 74th St. Mail: P.O. Box 12	33143 33157	757-8481	1310 N.W. 74th St., Mail: P.O. Box 47-796	33147	757-8481
MILWAUKEE, WIS.	5300 N. Sherman Blvd.	53209	462-3860	5300 N. Sherman Blvd., P. O. Box 299	53201	462-3860
MINNEAPOLIS, MINN.	500 Stinson Blvd.	55413	331-4050	Northwestern Terminal Bldg., 500 Stinson Blvd.	55413	789-7286
MOORHEAD, MINN.	1210-19½ St. So.	56560	233-5712	Minneapolis Serv. Dist., Northwestern Terminal Bldg., 500 Stinson Blvd., Minneapolis, Minn.	55413	331-4050
NEWARK, N. J.	133 Boyd Street	07103	824-5200	133 Boyd Street, Newark, N. J.	07103	824-5200
NEW ORLEANS, LA.	4800 River Rd., Mail: Box 10236, Jefferson Branch	70121	835-6421	4800 River Rd., Mail: P.O. Box 10236 Jefferson Branch, New Orleans, La.	70121	835-6421
NEW YORK, N.Y.	219 E. 42 St.	10017	751-1311	75-11 Woodhaven Blvd., Glendale, N. Y.	11227	896-6000
OAKLAND, CALIF.	999-98th Avenue	94603	569-3422	Oakland Serv. Dist., 999-98th Avenue, Oakland Calif.	94603	569-3422
OKLAHOMA CITY, OKLA.	Executive Terrace Bldg. 2809 N. W. Expressway	73116	842-4028	Dallas Serv. Dist., 6500 Cedar Springs Rd., Mail: P.O. Box 35425, Dallas, Texas	75235	351-3725
PHILADELPHIA, PA.	Rt. 202, At Expressway, King of Prussia, Pa.	19406	688-5900	Rt. 202, At Expressway, P.O. Box 299, King of Prussia, Pa.	19406	688-5900
PITTSBURGH, PA.	238 W. Carson St.	15219	471-9050	238 W. Carson St.	15219	471-9050
PORTLAND, ORE.				2800 N.W. Nela St.	97210	223-2101
ROCHESTER, N. Y.	Gibbs St. Bldg., 31 Gibbs St., Room 500	14604	454-2990	Buffalo Serv. Dist., 98 Hydraulic St., Buffalo, N.Y.	14210	856-0800
ROCK ISLAND, ILL.	101—31 Street, Mail: P.O. Box 66.	61202	788-3405	101—31 Street, Mail: P.O. Box 66	61202	788-3405
ST. LOUIS, MO.	1530 Fairview Ave.	63132	429-6930	1530 Fairview Ave.	63132	429-6930
SEATTLE, WASH.	2400—6th Avenue, South	98104	622-8081	2400—6th Ave., South	98134	622-8081
SPRINGFIELD, MASS.	120 Maple Street	01103	734-5606	Boston Service Dist., 50 Industrial Pl., Newton Upper Falls, Mass.	02164	332-6200
UTICA, N. Y.	c/o Radio Receiver Dept., P.O. Box 175, 1001 Broad St.	13501	724-1293	Buffalo Serv. Dist., 98 Hydraulic St., Buffalo, N.Y.	14210	856-0800
WEST HAVEN, CONN.	86 Tyler Ave.	06516	562-9828	New York Service Dist., 75–11 Woodhaven Blvd., Glendale, N. Y.	11227	896-6000

2-9-66

Progress Is Our Most Important Product

GENERAL ELECTRIC

PRINTED IN U.S.A. 3-4375-RR